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Nonlinear Rayleigh-Taylor and Richtmyer-Meshkov Mixing Experiments at Nova *

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Category A: Experimental studies of turbulent mixing

Abstract

The evolution of both the Rayleigh-Taylor (RT) and Richtmyer-Meshkov (RM) instabilities in a compressible medium was investigated in a series of indirect-drive experiments on Nova.

The RT experiments focused on the transition from the linear to nonlinear regimes for perturbation growth at an embedded, or classical, interface.[1] A gold cylindrical hohlraum was used to generate an x-ray drive which ablatively accelerated a two-layer package consisting of a 40 μm thick brominated plastic ablator backed by a 15 μm thick titanium payload. Various perturbations were placed at the plastic-Ti interface. Experiments were conducted with both single- and multimode perturbations and will be compared with simulations performed with a 2-dimensional radiation-hydrodynamics code. The multimode experiments have attempted to observe the process of *bubble competition* wherein neighboring structures either continue to rise or are washed downstream in the flow depending upon their relative size. This competition is predicted to result in an *inverse cascade* at late times where progressively larger structures will begin to dominate the flow. Experiments to date have shown evidence of coupled modes arising, but have not yet accelerated the interface long enough to produce the several generations of coupling required for a true inverse cascade.

A new experiment has been initiated to study both the transition from the linear to nonlinear regimes as well as the deep nonlinear behavior of a mix layer produced by the RM instability. This experiment builds on the work of Peyser *et al.*[2] which studied the evolution of a mix layer from a nonlinear initial perturbation ($\eta/\lambda \sim .5$) under the influence of a strong shock (M = 20). Again, an x-ray drive in a hohlraum is used to ablatively launch a strong shock into a 500 μm inner-diameter shock tube consisting of a 300 μm long section of high-density brominated plastic backed by several millimeters of low-density carbon resorcinol foam payload. A face-on geometry has been utilized to study the very early time ($<$ 6 ns after the shock reaches the perturbed interface) evolution of the interface. The experiment is also being extended to study the evolution of a well-developed mixing layer undergoing reshock by a counterpropagating second shock wave. The relative timing and strength of the two shocks will be varied and preliminary results will be presented.

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[1] K. S. Budil *et al.*, *Phys. Rev. Lett.* **76**, 4536 (1996).

[2] T. A. Peyser *et al.*, *Phys. Rev. Lett.* **75**, 2332 (1995).